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MISSION RIDGE - A CASE HISTORY OF SOIL DISTURBANCE AND REVEGETATION OF A WINTER SPORTS AREA DEVELOPMENT[1/]

by

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ABSTRACT

Areas of soil disturbance caused by construction of a winter sports area are identified, and the private operator's use of forest research findings to reduce the effect of these disturbances are reviewed.

Keywords: Environment, skiing, soil management.

[1/] *This paper was presented at the National Winter Sports Symposium, Denver, Colo., February 26 to March 2, 1973.*

First, I must acknowledge that I am both a winter sports enthusiast and a U.S. Forest Service research soil scientist interested in conserving nature's delicate balance in the near alpine forest environment. As a skier, I enjoy safe, well-groomed slopes. As a soil scientist, I see the need for minimal environmental impact, particularly with respect to soil disturbance. Recognizing that some compromise must be reached between these two desires, this presentation will attempt to identify the necessity of some soil disturbance at winter sports area developments and provide some of the technical knowledge needed to reduce the effect of these disturbances. In conclusion, an example of one positive relationship between required soil management and winter sports area development, the history of Mission Ridge, a recent ski area development near Wenatchee, Washington, is reviewed.

SOIL DISTURBANCE AND PROTECTION

Three reasons for soil disturbance in a winter sports development such as a ski area can be identified:

(1) construction of buildings and parking facilities,
(2) construction of roads,
(3) construction of trails and summer slope grooming.

Construction of the necessary buildings (lodges, lift towers, maintenance shops, sewage treatment facilities, etc.) and parking area normally involves areas of limited size. The possibility of condominiums or other service facilities increases the size of these areas. Thus, besides having very severe soil disturbance from construction, this area gets very heavy traffic during the operation of the facilities. Many opportunities exist for using landscape techniques for stabilizing disturbed soil areas, including planting of trees, shrubs, and lawns. Methods of providing acceptable minimum soil protection will be discussed later. Particularly in the area of structures and parking, plans must be made for water dispersal because of the reduction in land area available for infiltration and potential overland flow. Much of the soil disturbance and difficulty in establishing vegetative cover in these areas can be minimized by using good preconstruction planning.

Access roads to a development may cause major disturbance to the soils and can develop a high erosion potential. Since good engineering can reduce the impact of access roads, we will limit our discussion of this point. The most important feature to remember

is that winter sports developments are normally on north and east slopes where we are most likely to find unstable soils.

Limited engineering is the usual case for the lower level of installation and maintenance roads associated with winter recreation developments. The area and number of these roads should be kept at a minimum. It may be possible to include these roads effectively into a ski trail system. Wherever such roads are needed, they should be constructed with minimum impact on the hydrology of the area and should avoid unstable soil. Fords, culverts, waterbars, etc. should be used wherever necessary. Revegetation and other soil protection techniques needed would be similar to those used on graded trails.

On steeper slopes or where the soils are highly unstable, lift towers should be installed with a skyline or helicopter system. Hand construction should be used in building footings to keep equipment off these slopes.

Because of U.S. Forest Service and public concern about the ecology of subalpine areas used for winter recreation development, it appears unlikely that any large continuous areas will be cleared of trees and brush for skiing in the future. Thus, we might expect many future developments to provide trail-type skiing. Trails provide a rather narrow area with high use where snow management can be intensified. To provide the conditions necessary for good snow management at less expense as well as provide a more desirable and safer area for the skier, proper trail construction appears imperative.

In areas where the slopes are too steep for equipment (usually about 30- to 50-percent grade), clearing and summer slope grooming must be done by hand and soil disturbance kept at a minimum. For less critical slopes, equipment may be used and some soil disturbance might be permissible.

Ski trails and slopes may require some grading. Winter sports area developers should recognize that as development approaches the alpine zone, revegetation becomes increasingly difficult to accomplish. Any soil disturbance activity including grading of trails in this zone should be well planned. On the east slopes of the Cascade Mountains, revegetation becomes increasingly difficult to accomplish at over 5,000-foot elevation.

Thus, from our identification of possible areas of soil disturbance, it appears ski trails will most likely have the most extensive

area where revegetation is necessary for erosion control and good general grooming appearance. A number of management alternatives are available to insure satisfactory revegetation on ski trail and road system areas as well as around construction areas. They include:

(1) topsoil conservation. In the initial construction activity or trail grading, topsoil, if available, should be stockpiled and redistributed over exposed subsoil in the final grading.

(2) proper selection of plant species to be seeded. Species adaptability may be critical. Native species should be favored over introduced species, and this may require a seed collection program ahead of construction. Consideration might be given to annuals as well as perennials. Proper species information should be available from the U.S. Forest Service, Soil Conservation Service, or State university. If this information is not available for the local area, some plant screening trials may be required.

(3) soil fertility testing. County agents in connection with State universities normally provide this service for a small fee. Major nutrients of concern are nitrogen, phosphorus, potassium, and sulfur. Although there appears to be no general agreement on nitrogen fertilizer requirements for soil test data, we use a "rule of thumb" for a general guide in the establishment of vegetation on disturbed areas. We find that if the total nitrogen is 0.2 percent and above on upland slopes, nitrogen fertilization is not necessary. Nitrogen fertilization is generally advisable for plantings on disturbed upland soils when the total nitrogen is below 0.2 percent. If the total nitrogen is below 0.1 percent, nitrogen fertilization is usually necessary for satisfactory plant development. In some areas of the West, upland soils require sulfur fertilization for effective utilization of nitrogen fertilizers. In many cases, a starter fertilizer with about 50 pounds per acre total nitrogen applied at planting enhances the emergence and development of new grass seedlings on upland slopes.

(4) correct time of seeding. Winter sports areas usually have a relatively short summer season; thus, it would be difficult to separate differences between spring and fall plantings. Experience has shown that the most successful plantings are those made immediately after soil disturbance and where germination and emergence have occurred before permanent winter snow cover. Plantings should not be delayed until after precipitation and wind have caused "crusting" of the soil surface. If the summer months are quite dry, irrigation may be helpful to hasten plant establishment.

(5) seed and fertilizer covering. A shallow cover of soil over the newly planted seed and fertilizer enhances planting success. In areas of recent soil disturbance, natural soil compaction will normally sufficiently cover the seed and fertilizer. On areas where surface "crusting" has occurred, covering the seed and fertilizer can be accomplished by seeding with a rangeland drill or light harrowing after broadcast seeding. Covering the fertilizer, especially during warm, dry weather, with a shallow layer of soil will reduce possible nitrogen volatilization loss and increase the fertilizer's effectiveness.

(6) mulching. Mulches may be useful to provide more desirable soil moisture conditions for new seedlings. Many materials and methods are available. In windy areas, grass hay with an asphalt binder may be the most effective mulch. Chipping and distributing material from trail clearing may help and may reduce the need for burning.

(7) control of number of reoccurring soil disturbances. If at all possible, soil disturbing activities such as grading should involve careful planning so the job is done correctly the first time. Continuous soil redisturbance delays effective erosion control over an undesirable length of time.

(8) judging planting success after two growing seasons. Under most alpine or subalpine environments, planting of perennials will require at least 2 years before effective erosion control cover can be expected. Thus, judgment of success or failure of a planting cannot be made for most plantings in the first growing season. As an interim planting in high erosion potential areas, the use of a seed mix including annuals may be desirable. Cereal rye has been one of our most successful annuals planted on disturbed soils in the near alpine environment of north central Washington.

(9) use of maintenance fertilizer. To maintain healthy vegetation cover, particularly in high-use areas, a periodic maintenance nitrogen fertilization (perhaps every 2 to 3 years) may be necessary.

The above recommendations should assist the winter recreation manager to develop a good erosion control program as well as provide an attractive summer ground cover around his facilities.

AN EXAMPLE - MISSION RIDGE

Although a number of winter sports developments may have a good summer slope management program and Mission Ridge cannot

be considered unique in this respect, we are more familiar with its summer slope management history. Thus, we will use Mission Ridge as an example to show its choice of management alternatives to provide soil resource protection.

Mission Ridge, located 13 miles southwest of Wenatchee, Washington, opened in 1966 and is now in its seventh season of operation. The 2, 500-acre area from 4, 600-foot elevation at the base to nearly 6, 800 feet at the top is on Wenatchee National Forest and Washington State Department of Game lands. This northeast-facing, bowl-shaped basin includes the Squilchuck watershed providing domestic and irrigation water to residents of the lower valley.

Four chair lifts with a total length of 17, 600 feet can carry 3, 700 skiers per hour. Skiers have a choice of more than 20 major runs or trails. Buildings include a large day lodge, a ski patrol center and attendant dormitory, a shop, and a sewage treatment plant. Parking is provided for 750 cars next to the day lodge. A two-lane blacktop county road provides access to the area.

The geology of the basin is characterized by a cap of extrusive Columbia River basalts and consequent talus slopes overlying sandstones. The soils, whose parent material is generally basalt, are quite thin, making topsoil conservation nearly impossible for any soil disturbance activities. Overstory vegetation is predominantly western larch, lodgepole pine, subalpine fir, and Engelmann spruce. Understory vegetation is mostly needle grasses, lupine, and sedges. Numerous natural clearings in this vegetation are caused by the absence of soil on the talus slopes.

Before construction of the recreation development, the locations of buildings, lifts, and trails were outlined in an agreement between the operator and the U.S. Forest Service. A rather unique cooperation developed, as the construction engineer hired by Mission Ridge is Magnus Bakke, a retired local Forest Service engineer and an internationally known ski activity participant. Thus, the developing organization was fortunate to have an individual knowledgeable in U.S. Forest Service construction requirements and soils and vegetation characteristics of the area, as well as having an understanding of ski slope requirements.

The most extensive severe soil disturbance involved construction of the day lodge and the parking lot. An example of the construction engineer's concern about structures and soil disturbance is the use of

a wooden off-loading ramp at the top of one of the lifts. Use of a fill, as advocated by some of the staff, would have been less expensive but would have left an extensive disturbed area visible from the Wenatchee valley. Besides reducing the possible hazard of overloading the slope and initiating mass soil movement, the present structure blends nicely into the surrounding vegetation. An example of the operator's concern is a lift visible from the lodge--acknowledging that a straight line through forest vegetation is esthetically unpleasant; only the large trees were felled beneath the lift line and the smaller trees and understory vegetation remain undisturbed. Lift towers were moved into position with a skyline system.

The road to the recreational area was constructed by Chelan County. The route used was along a proposed Forest Service access road, and Forest Service and county funds were used in the project. Almost all the land along the 4 miles of road construction is in private ownership. This road was built at a minimum construction cost. No funding was provided for erosion control and the cutbanks are oversteepened. Thus, the roadbanks are a serious source of erosion by runoff, slumping, and dry ravel.

One installation and summer maintenance road designed for minimum impact was constructed to the top of the development. It was particularly necessary to keep disturbance by this road to a minimum because of the numerous springs supplying summer water to valley residents. The road is kept closed to all but essential maintenance traffic. The road is integrated into the trail system to provide an easy "run" from the scenic viewpoint on top to the base area. The presence of talus made road surface material available locally when needed and possibly reduced an erosion hazard.

Trails on steep slopes were hand-cleared and the slash burned. Stumps and fallen logs were removed. On the lesser slope, about 100 acres of trail area were graded. Also, grading was used to remove adverse trail conditions such as "waterfalls" (areas of very steep descent) and to control water runoff. Because of the soils in the area, surface conditions after grading tended to be "armored" by exposure of rock. But the soils of the area are quite permeable, and the reduction in soil surface area available for water infiltration did not appear to increase the erosion potential. The operator's use of curved and contoured trails limits the unpleasant straight-line view as well as provides better snow management and ski traffic control.

Underground power and communication cables to a communication station on top of the ridge follow a cleared trail slope near the top of the development. In the early spring of 1968, a cable needing repair was excavated from the apparently highly erodible soil in which it was trenched. Later in the spring melt period, considerable local erosion did occur. This was emergency work in which the recreation area management and the Forest Service appeared to have limited opportunity to provide erosion protection.

In the Forest Service area use permit, the operator was required to revegetate the exposed slopes. In the late fall of 1967, the disturbed areas were seeded with a mixture of orchard grass, timothy, and hard fescue. The seed was broadcast on top of a blanket of snow. In the summer of 1968, the only evidence of the previous fall planting was on undisturbed topsoil and near ski lifts where chemicals had been used to condition the snow. The moisture and temperature conditions did not appear responsible for the absence of new seedlings in the disturbed areas.

At this point, scientists at the Pacific Northwest Forest and Range Experiment Station Forest Hydrology Laboratory in Wenatchee became involved in the problem of revegetation. Involvement in this problem on ski slopes was also related to possible future problems on nearby National Forest land that may be disturbed by wildfire and fireline construction.

Initially, soil samples collected from the disturbed areas on the ski slopes were chemically analyzed for a possible cause for the limited success of the first planting. All plant nutrients were found to be low with the nitrogen measured at 0.02 percent. A greenhouse study was initiated to confirm that the soil nutrient supply was one of the major limiting factors in revegetating the ski slopes. Crested wheatgrass seeds planted in unfertilized containers grew only until their endosperm energy was exhausted and then slowly died. Containers of fertilized soil grew an abundant quantity of healthy grass.

In late August, a field trial was established in the middle of one of the major ski runs. Crested wheatgrass, common ryegrass, and a mixture of orchard grass, timothy, and hard fescue was broadcast in plots 15 by 40 feet. One half of each plot received a starter fertilizer at planting. Nitrogen in the form of urea was applied at the rate of 100 pounds per acre, phosphorus (P205) as single superphosphate at 100 pounds per acre, and potassium (K20) as muriate of potash at 100 pounds per acre. The surface soil was lightly harrowed to cover the seed and to minimize fertilizer loss due to volatilization.

Seventeen days after planting, a high percentage of seedlings had emerged on the half of the plot receiving starter fertilizer, but the low percentage of seedlings on the unfertilized section of the plot was conspicuous. This difference after planting and subsequent winter survival was very evident when the snowpack melted off the plots in May 1969. At this time, all fall unfertilized plantings were fertilized with 100 pounds of nitrogen per acre in the form of urea. The vegetative growth of the half of each plot receiving a starter fertilizer[2/] was spectacular. This excellent growth was in contrast to the low productivity on the plots not receiving a starter fertilizer.

One section of the test area was broadcast planted on top of snow in late fall to duplicate previous planting attempts. Although a generous quantity of orchard grass, timothy, and hard fescue was planted, very few seedlings emerged the following spring. This test demonstrated that broadcast planting on snow is not a recommended practice in this area.

The results of these field tests[3/] demonstrate that the method of planting at this location is perhaps as important as the choice of seed mixture. Here, it was important to use a starter fertilizer with a thin layer of soil over the seed. Spring planting would most likely be successful with this practice, but wet soil conditions along with late snowmelt runoff makes such plantings impractical.

Using the planting and fertilizing techniques practiced in this study, the operators of Mission Ridge have made successful plantings. The successful planting procedures developed here would be adaptable to revegetating areas disturbed by winter sports developments in many places along the upper slopes of the West.

In summary, it appears that a reasonable land use plan by the U.S. Forest Service and the Mission Ridge management provides an excellent recreation area with a minimum impact on the soil resource. The best test for those concerned about the development's effect on the environment would be its effect on the domestic water supply in the lower valley. No change in water quality has been measured although the county access road poses a potential threat of sedimentation.

[2/] G. O. Klock. *Use of a starter fertilizer for vegetation establishment. Northwest Sci. 43(1): 38, 1969.*

[3/] G. O. Klock and W. A. Hampton. *Skiing--'and on a grass base.' Wash. Farmer-Stockman 97(2): 34, 1972.*

For the operator, summer grading and grooming of trails has been financially rewarding. The early snowpack in the 1972-73 season has been unusually low. Without summer grooming which provided slope conditions necessary for proper winter grooming, operation of the ski area in December and early January would have been doubtful. In 1 week during December, Mission Ridge lift receipts were large enough to pay for the total investment in trail clearing and summer grooming, including seeding and fertilizing for erosion protection.

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